

METEOROLOGICAL TOWER HOIST OPERATION

Purpose This Meteorology and Air Quality Group (MAQ) procedure describes the requirements for operating the tower instrumentation hoists to provide access to the tower instrumentation.

Scope This procedure applies to the individuals who operate these hoists and winches to lower or raise the booms or tilt the towers. This procedure documents hoist operation only – the instrumentation work is described in MAQ-404, “Repairing, Maintaining and Calibrating Meteorological Instruments in the Field”.

In this procedure This procedure addresses the following major topics:

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02/09/05

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General information

Attachments This procedure has the following attachments:

Number	Attachment Title	No. of pages
1	Hazard Review	2

History of revision This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	2/8/05	New document.

Who requires training to this procedure? The following personnel require training before implementing this procedure:

- MAQ meteorological instrumentation technician

Annual re-training to this procedure is required.

Training method The training method for this procedure is **on-the-job** training to be conducted by a previously-trained individual and will be documented in accordance with the procedure for training (MAQ-024).

Annual retraining for this procedure will be by self-study (“reading”) training.

Prerequisites The following training is required before performing this procedure:

- Incidental Crane Operator training (course no. 20296)
- TS2500 hoist operations manual by Tower Systems, Inc (TSI)
- RRES-ES-Field, “Field Safety For All Employees”
- RRES-ES-Driving, “Driving and Towing Safety For All Employees”

Definitions specific to this procedure None.

General information, continued

References

The following documents are referenced in this procedure:

- MAQ-024, “Personnel Training”
 - MAQ-401, “Meteorological Tower Climbing and Support”
 - MAQ-404, “Repairing, Maintaining and Calibrating Meteorological Instruments in the Field”
 - LIR 402-1120-01.0, “Cranes, Hoists, Lifting Devices, and Rigging Equipment”
 - LIG 402-10-01A, “Lightning Safety”
 - TS2500 hoist operations manual by Tower Systems, Inc (TSI)
 - RRES-ES-Field, “Field Safety For All Employees”
 - RRES-ES-Driving, “Driving and Towing Safety For All Employees”
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Note

Actions specified within this procedure, unless preceded with “should” or “may”, are to be considered mandatory guidance (i.e., “shall”).

Hoist Operation for the TA6, TA49, TA53, and TA54 towers

Background and tower locations

The tower climbing procedure (MAQ-401) provides the background and describes the locations of all the meteorological towers. MAQ-401 describes all of the meteorological measurement sites – not all of these sites have towers or hoists. The meteorological instrument maintenance procedure (MAQ-404) provides access information for each of the sites and describes the work processes to install, replace, or maintain the instruments after they are lowered according to this procedure.

Hoist type

The towers at TA6, TA49, TA53, and TA54 all have the same model TS2500 instrument hoist manufactured by Tower Systems, Inc (TSI). The hoist (or winch, in some documents) system is used to raise instrument carriages to predetermined positions on the towers. The carriages ride on rails attached to one face of the tower and are lifted by the hoist's lifting cable.

Hoist configuration

Each carriage is clamped to the common lifting cable at a precise position so that the carriages all plug into their respective signal connectors simultaneously. In this way the signals from the instruments are connected to the data logger located at ground level. When a carriage plugs into its respective connector a switch closure is detected by the hoist control and the hoist electric motor stops. The hoist control has an "override" switch and the carriage connectors have a limited spring-load that allows the operator to ensure that all the carriages are connected.

Conversely, when the instrument carriages are lowered to the ground for removal, there is a limit switch that stops the hoist when a carriage reaches the ground level. The override switch is used to adjust this ground level position to facilitate removal of the carriages. The carriage lowered to ground level must be removed before the next carriage can be lowered.

Equipment and supplies

LIR 402-1120-01 specifies the use of the following PPE when operating a hoist:

- Safety shoes, safety glasses and a hard hat
- Leather work gloves
- pager and cell phone

Bring a copy of form 1591, Monthly Inspection Record for Fixed Hoists.

Hoist Operation for the TA6, TA49, TA53, and TA54 towers, continued

Description of hoist controls The hoist control, which is located in a weather tight box at ground level for operator convenience, has the following controls:

- A 20 amp push-button circuit breaker that is also used as the system power switch.
- A momentary action “limit-override” switch that will override the limit switches that stop hoist operation. This switch is used to fine-tune the position of the carriages.
- A two-position “up/down” switch that controls whether the hoist runs to raise the instrument carriages or lower them.
- A two-position “off/on” switch with a guard that energizes the override and up/down switches allowing them to operate.

Number of carriages The instruments mounted on the carriages do not vary, so the hoist always lifts the same load. There are five carriages on the TA6 tower; three on each of the TA49 & 53 towers; and four carriages on the TA54 tower. Refer to the TS2500 operations manual for adjustments and maintenance of the hoists.

Steps to lower the carriages To lower the carriages, perform the following steps:

Step	Action
1	Loosen the two screws that secure the cover to the hoist control weather tight box.
2	Before running the hoist, ensure that the lifting cable is unfettered and do a visual check to make sure that everything looks as it should. Note: Because of the additional loads at TA6 and TA54, there is typically slack in the lifting cable as it emerges from the hoist housing. At TA54, tie the lifting cable to the tower leg and at TA6 there is a prop that keeps this slack section of cable from blowing in the wind – which might abrade the cable. Cable slack at TA49 & 53 is typically non-existent.

Hoist Operation for the TA6, TA49, TA53, and TA54 towers, continued

Step	Action
3	<p>Before activating the hoists at TA6 & 54, the operator must remove this slack from the cable by manually tensioning the lifting cable as it emerges from the top of the hoist housing. This is necessary so that the cable does not get cross-fed within the hoist housing. Cross-feeding can damage the lifting cable.</p> <p>Caution: Within the hoist housing, the cable makes several passes around two sets of drive pulleys and if there is slack in the cable, it may catch on an adjacent set of pulleys and get jammed-up or cross-fed.</p>
4	Open the hoist control box cover and push in the 20 amp circuit breaker that applies power to the hoist control box.
5	With the cable tensioned, as necessary, lift the mechanical switch guard and turn-on the winch control “on/off” switch. Note: Because the carriage interlock switches are activated, the winch will not run.
6	Set the hoist “up/down” switch to the “down” position.
7	<p>Activate the “limit override” switch and the hoist will begin lowering the instrument carriages. After about 6” of travel, release the “override” switch and the hoist will continue to run.</p> <p>Note: If for any reason it is necessary to stop the hoist, simply close the switch guard over the “on/off” switch – this will shut off the switch and the hoist.</p>
8	<p>The hoist will continue to run until the bottom carriage activates the “bottom travel limit switch” whereupon the hoist will stop.</p> <p>During this period with the hoist running:</p> <ul style="list-style-type: none"> • Stay near the hoist control in case it is necessary to stop the hoist for any reason. • At TA6 and TA54, a signal cable that connects the bottom carriage to the tower J-box is attached to the lifting cable with clips. As the carriage is lowered, un-clip this cable from the lifting cable. Be very careful not to allow the clips or cable to get caught in the winch. • Listen for strange sounds that might indicate a problem. • Examine the lifting cable for damage as it moves past.
9	<p>With the bottom carriage at this “parked” position where it activated the “bottom travel limit switch” the operator needs to prepare for the removal of this carriage so that the next carriage maybe lowered.</p> <p>Note: The operator shall shut off the hoist control “off/on” switch to do this preparation.</p>

Hoist Operation for the TA6, TA49, TA53, and TA54 towers, continued

Step	Action
10	The carriage's position on the lifting cable must be marked so that the carriage may be reattached to this exact position. There is about 12" of lifting cable visible between the top and bottom cable clamp positions. Use white spray paint to make this area more noticeable (since it has been spray painted in the past, this may not be necessary). Use a measuring tape and locate a point 6" down from the carriage's upper horizontal bracket. Using a black Sharpie pen, carefully mark the circumference of the cable so that the cable has a ring around it at this 6" position.
11	Remove the carriage's bottom cable clamp that attaches the carriage to the lifting cable. Note: The carriage's top cable clamp will hold the carriage in position.
12	Install the "gap-fillers" in the gap between the bottom of the rail system and the top of the hoist housing. The gap-fillers simply rest on the hoist housing and have a lock-bolt that engages the bottom of the two rails. Note: The gap-fillers are adjustable to provide a proper fit.
13	Connect a carriage signal jumper cable between the carriage's signal connector and the appropriate connector on the tower J-box. Note: The limit switch lamp, within the hoist control box, will illuminate indicating that the jumper cable is properly plugged-in. This connection activates the hoist control's limit switch system and will require activation of the override switch for any hoist movement. This jumper cable also connects all the carriage's instruments just as they are when the carriage plugs into its mating connector up the tower.
14	Turn on the hoist control "off/on" switch and then momentarily activate the "override" switch to move the carriage down onto the gap-filler. When the carriage just clears the bottom of the tower mounted rails, release the "override" switch. Warning: If you fail to connect the carriage to the tower J-box with a jumper cable, then the hoist will run freely when the carriage clears the "bottom travel limit switch" – the carriage will impact the hoist housing and there may be damage.
15	Turn off the hoist control "off/on" switch.
16	The carriage must now be locked to each of the gap fillers with large cable-ties. Note: It is too difficult to try to describe this process – it is necessary to demonstrate this process to a new operator.
17	Remove the carriage's top cable clamp and disconnect the jumper cable. The carriage is now free of the lifting cable and is cable-tied to the gap-fillers.

Hoist Operation for the TA6, TA49, TA53, and TA54 towers, continued

Step	Action
18	Un-latch the gap-fillers from the bottom of the tower's rail system.
19	Stand beneath the carriage, with the carriage's boom tubing resting on the operator's shoulders. Lift up the carriage assembly and move it away from the tower. There are stands located near the tower that will receive the carriage assembly and hold it by engaging the gap-fillers.
20	Turn on the "off/on" switch and the hoist will bring the next carriage down to the "bottom travel limit switch".
21	Repeat steps 8 through 20 for the remaining carriages.
22	The last, or top carriage, is not removed from the tower. The operator can perform required maintenance by accessing this carriage's instruments with a ladder.
23	Turn off the hoist control "off/on" switch.

Steps to raise the carriages

To raise the carriages, perform the following steps:

Step	Action
1	Since the top carriage is not removed from the lifting cable, the first step is to simply raise this carriage until the next carriage's position on the cable becomes visible above the hoist housing.
2	Turn on the hoist control "off/on" switch and set the hoist "up/down" switch to the "up" position.
3	Activate the "limit override" switch and the hoist will begin raising the instrument carriage. After about 6" of travel, release the "override" switch and the hoist will continue to run. Note: If for any reason it is necessary to stop the hoist, simply close the switch guard over the "on/off" switch – this will shut-off the switch and the hoist.

Steps continued on next page.

Hoist Operation for the TA6, TA49, TA53, and TA54 towers, continued

Step	Action
4	<p>Watch the lifting cable as it emerges from the hoist housing. When the white-painted part of the cable is visible, stop the hoist with the switch. During this period with the hoist running:</p> <ul style="list-style-type: none"> • Stay near the hoist control in case it is necessary to stop the hoist for any reason. • At TA6 and TA54, a signal cable that connects the bottom carriage to the tower J-box is attached to the lifting cable with clips. When the bottom carriage is installed, “re-clip” the signal cable to the lifting cable as the winch raises the carriage to its operating position. • Also, at TA6 and TA54 when the last carriage is installed, the load is such that the lifting cable will have some slack. As the last carriage is raised, the operator must manually tension the cable to remove this slack to avoid cross-feeding within the winch. • Listen for strange sounds that might indicate a problem. • Examine the lifting cable for damage as it moves past.
5	Retrieve the next carriage from its stand and place it in the gap between the bottom of the tower’s rail system and the top of the hoist housing. Engage the gap-filler lock bolts with the tower rails.
6	<p>Connect a carriage signal jumper cable between the carriage’s signal connector and the appropriate connector on the tower J-box.</p> <p>Note: This connection activates the hoist control’s limit switch system and will require activation of the “override” switch for any hoist movement. The limit control light for this carriage position will illuminate.</p>
7	<p>Turn on the “off/on” switch.</p> <p>Note: The hoist will not run because this carriage has activated the hoist control limit switch system.</p>
8	Hold a measuring tape in the space between the top and bottom brackets of the carriage where the lifting cable is visible. Bump the “override” switch until the black mark on the lifting cable (made before the carriage was removed) aligns with the 6” mark on the measuring tape.
9	Turn off the “off/on” switch.
10	Install the top cable clamp that attaches the carriage to the lifting cable.

Steps continued on next page.

Hoist Operation for the TA6, TA49, TA53, and TA54 towers, continued

Step	Action
11	Cut the cable-ties that secure the carriage to the gap-fillers and remove the remnants. Caution: Be careful to re-install all the cable clamps on each carriage. If cable clamps are left-over after all the carriages have been raised, then the operator will need to lower the carriages to locate the carriage which doesn't have all the required clamps.
12	Turn on the "off/on" switch and with the jumper cable still connecting the carriage to the J-box, raise the carriage onto the tower rail system so that the gap-filler maybe removed.
13	Turn off the "off/on" switch.
14	Install the bottom cable clamp that attaches the carriage to the lifting cable.
15	Do a final inspection of the boom and instrumentation and then disconnect the jumper cable that connects the carriage to the J-box.
16	Turn on the "off/on" switch.
17	Activate the "limit override" switch and the hoist will begin raising the instrument carriages. After about 6" of travel, the carriage will be clear of the bottom travel limit switch, at which point the operator can release the "override" switch and the hoist will continue to run.
18	Repeat steps 4 through 17 for the remaining carriages.
19	When all the carriages are lifted to their operating positions, a light for each level will illuminate in the hoist control box.
20	If one or more of the lights have not illuminated, bump the carriages up with the "override" switch by momentarily depressing the switch. Note: The spring loaded connectors on each carriage only have about 2" of travel. If a carriage is not properly positioned on the cable, then it will be necessary to re-position that carriage. To do that, the operator must lower and remove carriages until the miss-positioned carriage is accessible.
21	Once all the lights (corresponding to the number of carriages) are illuminated, pull the 20 amp circuit breaker switch which will remove power from the hoist control.
22	Close the hoist control box cover and tighten the two screws.
23	Complete form 1591, Monthly Inspection Record for Fixed Hoists. Submit the form to the group records coordinator to be filed with Meteorology team records. Note: This form specifies monthly inspections, but the LIR requires that this form also be used whenever "infrequently operated" hoists are used.

Hoist operation for the TA5-61 (MDCN) Tower

Description This tower is a 10 m tilt-over tower with a tripod base. The tower pivots at the bottom of the tripod base and is pinned in a vertical position at the top of the tripod base. A hand crank winch is used to tilt the tower over to a horizontal position for access to the meteorological instruments. The hand crank winch is attached to the tripod base.

Steps to lower the tower To lower the tower, perform the following steps:

Step	Action
1	Disconnect the guy cables that connect the top of the tower to the base to allow the tower to be tilted.
2	Remove the bolt that pins the tower at the top of the tripod base.
3	Feed out a small amount of the winch cable and push the tower in the direction that it tilts to move it off the vertical position.
4	Once the tower is starting to tilt or lean toward the proper direction, then crank out the winch cable until the tower is lowered to the desired position.

Steps to raise the tower To raise the tower, perform the following steps:

Step	Action
1	Raise the tower back to a vertical position with the hand crank winch.
2	When the vertical position is reached, re-install the bolt that pins the tower in a vertical position.
3	Re-connect the guy cables that connect the top of the tower to the base.

Hoist operation for the TA41-64 Tower

Description

This is a 21 m telescoping tower that tilts over after the tower is collapsed to its nested 8 m height. The tower is self-supporting via the base unit which is set in concrete. The tower consists of several sections that telescope to the extended height with an electric winch that winds the lifting cable up (or off) of a drum. When the tower is collapsed to its minimum nested height, then and only then may the tower be tilted-over with a hand-cranked winch to provide access to the meteorological instruments (see MAQ-404).

The hinge point for the tower is about six feet above the ground level so when the tower is tilted over, a ladder will be necessary to access some of the instruments.

Steps to lower the tower

To lower the tower, perform the following steps:

Step	Action
1	Plug the power cord for the telescoping winch motor into the electrical outlet at the tower base.
2	Retrieve the winch control key from the data logger shelter (ice chest).
3	Insert the key in the winch control and activate the winch control.
4	Depress the momentary-action switch and lower the tower until the bottom limit switch is activated.
5	Un-plug the winch power cord and disconnect the limit switches connectors from the winch control.
6	Remove the large bolts that attach the bottom of the tower to the tower base support unit. Warning: The <u>tower must be nested</u> or collapsed to its minimum height <u>before removing these bolts</u> – the tilt-over winch is not designed to tilt a fully extended tower.
7	Feed out a little slack in the cable from the hand crank tilt-over winch.
8	Use a pry-bar to pry the tower away from the tower base to begin tilting the tower. It will probably be necessary to feed out a little more slack and then pry on the tower once or twice more until the tower's weight shifts from the balanced vertical position.
9	Once the tower shifts from the balanced vertical position then the operator only needs to continue cranking out the cable until the tower is near horizontal.

Hoist operation for the TA41-64 Tower, continued

Steps to raise the tower To raise the tower, perform the following steps:

Step	Action
1	With the tilt-over winch, crank-in the cable to raise the tower back to a vertical position.
2	It may be necessary to use the pry-bar to align the tower bolt flanges with the base unit bolt flanges.
3	With the holes in the bolt flanges aligned, re-install all the bolts that connect the tower to the base unit.
4	Plug the winch power cord back into the electrical outlet and reconnect the two limit switches to the winch control.
5	Press (up) the momentary-action switch to raise the tower.
6	While the tower is being raised, watch the instrument signal cables to ensure that cables do not get tangled.
7	Raise the tower until the top limit switch is engaged or the sound from the winch motor changes indicating that the tower is fully extended. Note: The instrument signal cable bundle will be taut at this point.
8	Shut off the winch control key and remove it from the winch control. Put the key back into the data logger shelter.
9	Unplug the winch power cord from the electrical outlet.
10	Complete form 1591, Monthly Inspection Record for Fixed Hoists. Submit the form to the group records coordinator to be filed with Meteorology team records.

Hoist operation for the TA59 Tower

Description

This is a 21 m telescoping tower that collapses to its nested 8 m height. The tower is self-supporting via the base unit which is set in concrete. The tower consists of several sections that telescope to the extended height with an electric winch. When the tower is collapsed to its minimum nested height, then the operator can use a ladder, attached to the tower, to access instruments on the tower. At this time, the only thing on the tower is an antenna that is part of the communication link from the sodar to the met lab (TA59/bldg. 001/rm.178).

Steps to lower the tower

To lower the tower, perform the following steps:

Step	Action
1	Turn on circuit breaker 7, of lighting panel LP-40 located in room 178.
2	Go out to the tower and move the winch control switch to “down”. The motor will start and the tower will begin lowering.
3	Stay within reach of the winch control switch while the tower is being lowered. Look and listen to ensure that the tower is lowered properly.
4	When the tower reaches its minimum height, a limit switch will stop the motor. To provide a more accessible work environment, the operator should stop the winch before it reaches this minimum height.
5	When the tower is lowered to the desired height, place the winch control switch in the “off” position.
6	Before climbing up to the work platform, shut off circuit breaker 7 of LP-40.

Steps to raise the tower

To raise the tower, perform the following steps:

Step	Action
1	Turn on circuit breaker 7 of LP-40.
2	Back out at the tower base, move the winch control switch to “up”. The motor will start and the tower will begin to raise.
3	Stay within reach of the winch control switch while the tower is being raised. Look and listen to ensure that the tower is raising properly.
4	A ground cable and antenna signal cable must also be scrutinized to ensure that they do not get caught or tangled as the tower is raised.
5	When the tower is raised to its maximum height, a limit switch will stop the motor.
6	Place the winch control switch to the “off” position.
7	Turn off circuit breaker 7 of LP-40.

Steps continued on next page.

Hoist operation for the TA59 Tower, continued

Step	Action
8	Complete form 1591, Monthly Inspection Record for Fixed Hoists. Submit the form to the group records coordinator to be filed with Meteorology team records.

Emergencies

In case of an emergency

In an emergency situation, use the cellular telephone to call 911 to request appropriate assistance. Contact the MAQ group office at 5-8855 as soon as practical.

Records resulting from this procedure

Records

The following records generated as a result of this procedure are to be filed **within two weeks** with the group records coordinator:

- biennial (every two years) inspections performed by KSL. These records must be permanently retained.
- form 1591 Monthly Inspection Record for Fixed Hoists, each time a hoist is operated. (This form specifies monthly inspections, but the LIR requires that this form also be used whenever infrequently operated hoists are used.) These records must be retained for one year.

HAZARD REVIEW FOR METEOROLOGICAL TOWER HOIST OPERATION

Work tasks/Steps	Hazards, Concerns, and Potential accidents; Likelihood/ Severity	Controls, Preventive Measures (e.g., safety equipment, administrative controls, etc.)	Emergency actions to take in event of control failures
Any hoist operation	Worker injury from equipment that might be dropped or might fall during hoisting operations.	Use required PPE: safety shoes, safety glasses and a hard hat. The operator will have a pager and a cell phone in case of injury. Only the meteorology instrumentation technician is authorized to operate the tower winches. At each use, complete the form 1591 "Monthly Inspection Record for Fixed Hoists" from LIR 402-1120-01.0, "Cranes, Hoists, Lifting Devices, and Rigging Equipment"	Use the cellular telephone to call 911 to request appropriate assistance. Contact the MAQ group office at 5-8855 as soon as practical.
Task: Lower booms using motorized hoist, as described in procedure MAQ-408 chapter "Hoist Operation for the TA6, TA49, TA53, and TA54 towers"	Pinches, minor cuts	Gloves for operations that involve handling cable or booms.	Same as above.
Task: Lower tower using hand winch, as described in procedure MAQ-408 chapter "Hoist operation for the TA5-61 (MDCN) Tower"	Pinches, minor cuts	Gloves for operations that involve handling cable or booms.	Same as above.
Task: Telescope tower and tilt over using motorized winch and hand winch, as described in procedure MAQ-408 chapter "Hoist operation for the TA41-64 Tower"	Pinches, minor cuts	Gloves for operations that involve handling cable or booms.	Same as above.

Work tasks/Steps	Hazards, Concerns, and Potential accidents; Likelihood/ Severity	Controls, Preventive Measures (e.g., safety equipment, administrative controls, etc.)	Emergency actions to take in event of control failures
Task: Telescope tower using winch, as described in procedure MAQ-408 chapter "Hoist operation for the TA59 Tower"	Pinches, minor cuts	Gloves for operations that involve handling cable or booms.	Same as above.

Wastes or residual materials resulting from process

None.

Emergency actions to take in event of control failure

For all injuries, provide first aid and see that injured person is taken to Occupational Medicine (only if immediate medical attention is not required) or the hospital. Notify supervisor and group office as soon as possible.